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IMAGINAL MNEMONICS IN A PAIRED-ASSOCIATE LEARNING TASK

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Imaginal Mnemonics in a Paired-Associate Learning Task

submitted by David C. Kwok

in partial fulfilment of the requirements for the degree of

Master of Education

in Educational Psychology

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ABSTRACT

The purpose of this study was threefold: (1) To compare two kinds of imaginal strategies (formation of functional or nonfunctional interactive images) in a paired-associate learning task. (2) To examine the relative effectiveness of picture pairs and word (concrete noun) pairs as stimulus materials. (3) To investigate recall performance as a function of time. A 2x2x2 factorial design was employed in this study. Subjects were eight groups of university students randomly assigned to one of the eight experimental conditions (a total of seventy-one subjects). A three way analysis of variance was conducted to analyze the data. It was found that functional imaginal strategy was no more facilitating to retrieval than nonfunctional imaginal strategy. Pictorial stimuli were more facilitating to retrieval than word (concrete noun) stimuli. There was a drastic decline of retrieval performance after a period of one week.

The 'no difference' finding between the use of functional and nonfunctional imaginal strategies was interpreted as to indicate that because of the inefficiency of forming nonfunctional images, subjects quickly abandoned this strategy and employed a more 'natural' kind of imaginal mediation which resulted in comparable performance as compared with subjects instructed to form functional images. Some educational implications were discussed with regard to

the superiority of the pictorial mode of representation in paired-associate learning. The drastic decline of recall performance after a period of one week posed some problems with regard to the use of a pure form of imaginal mediation as a mnemonic device for long-term memory. Some limitations of the study were also discussed.

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Chapter 1

INTRODUCTION

Historical Background of Imagery Research

The subject matter encompassed by the present research study is imagery mnemonics. Basically, a mnemonic can be called a 'pre-established scheme imposed upon new information' (Short, 1975, p.4). Such a 'pre-established scheme' can be verbal or imaginal. An example of a verbal type of mediation on a paired-associate (PA) learning task is to form a phrase or sentence containing the stimulus and response members of the pair. An example of imaginal mediation is the forming of images of the objects represented by the stimulus and response members of the pair and visualizing these images in some form of interaction. Since the present study examines the role of imaginal mnemonics in a PA learning task, the following discussion is focused upon these. However, attention is also given to those areas of verbal mnemonics which relate to imagery.

Perhaps it was Sir Francis Galton who expressed the earliest recorded interest in the scientific investigation of imagery. He constructed the first questionnaire and made one of the first statistical surveys to investigate individual differences in the vividness of imagery (Galton, 1880). Besides Galton, structuralists such as Titchener

(1919) were interested in the use of introspection to study the content of imagery.

In the early part of the 20th century, different experimental approaches were employed to study imagery. Some researchers attempted to form a classification system which would categorize people on the basis of the type of imagery they used (Betts, 1909; Ferald, 1912). Others investigated the relationship between imagery and intelligence (Carey, 1915). However, with the rise of behaviorism in the second decade of the century, there was a corresponding decline in the popularity of studying imagery. Behaviorism was largely influenced by John B. Watson (1913, 1930) who argued that psychological experiments should be restricted to the study of observable, measurable behaviors. On the basis of his own philosophical outlook and the experimental evidence then available, Watson came to the conclusion that mental images were mere "ghosts" without any functional significance.

It was not until the mid 1950's that imagery had re-emerged as an important area of study in psychology. The re-emergence of interest can partly be attributed to some entertainers who advocated the practical use of imagery as a memory aid (e.g. Furst, 1957; Lorayne, 1957). There were other more important reasons. A number of practical problems have reawakened the psychologist's interest in the study of imagery. Holt (1964) suggests that when we

consider some of the accidents which imagery or hallucination (imagery in its most dramatic form) may cause (e.g., victims of "highway hypnosis"), practical people are not likely to be impressed by the argument that imagery is not worthy of scientific investigation because it is mentalistic and impossible to experiment on with animals. Holt further suggests that developmental psychology has been important in contributing to the re-emergence of studying imagery. For example, Bruner (1964) refers to early use of imagery as "iconic representation" which is the second stage of representation in his theory of cognitive development.

Today imagery studies are frequently reported in verbal learning literature. Special attention is given where it is used as a mediational device (see Paivio, 1971 for review of the large numbers of studies conducted in the 1960's).

The following sections review literature related to mnemonics with particular attention given to imaginal mnemonics. The various theories relating imaginal mediation to learning will also be discussed.

Review of Related Literature

Usefulness of Mnemonic Devices in General

There is little disagreement in the literature on the function of using mnemonic devices in verbal learning and memory tasks. A large number of studies support the

efficacy of mnemonics when compared with no instructions to use mnemonics. Bulgelski (1962) found that pairs of nonsense syllables for which some kind of mediation could be formed were most easily learned. Clarkson, et al., (1973), Cook (1973), McNicol and Ryder (1973), Paivio and Yuille (1969), Rowe and Smith (1973), and Short (1975) report that instructions to use mediation facilitated recall and/or recognition when compared with control groups which were given either repetition instructions or no instructions in PA learning. Other studies have supplied subjects with mediators (Davidson, 1964; Davidson and Adams, 1970; Denis, 1975). All these studies demonstrate the superiority of supplied mediation in recognition as compared with a no-mediation control group. With serial learning, Persensky and Senter (1969) have demonstrated that the groups which were instructed to use mnemonics performed at a level superior to that of groups which had equivalent rote practice. Thus, it appears that there is general agreement as to the effectiveness of mnemonics in verbal learning and memory tasks.

Usefulness of Verbal Mnemonics

Martin, Boersma and Cox (1965) used a seven-level category (from no reported associations to syntactical association) to classify subjects' post hoc reports of associative strategies in PA learning. It was found that higher level strategies were generally correlated with

better performance. This study offers evidence for the usefulness of verbal mnemonics since the lowest level strategies were repetition and no reported associations.

Many studies have been conducted to investigate the role of natural language mediators (NLMs) in PA learning. NLMs can be defined as the idiosyncratic association that an individual imposes upon verbal items when attempting to learn them (Kiess, 1968). Adams and McIntyre (1967) report that NLMs gave better recall than rote learning provided that the NLMs used in original learning were remembered. Kiess (1968) attempted to assess the relationship of NLMs to recall in short-term memory. It was found that items for which NLMs were used were better retained than rote learned items at intervals of 5, 10, 15 or 30 seconds but not at immediate recall. Smith (1969) reports that the facilitative effect of NLMs could be extended over a retention interval as long as nine days. While the recall of pairs learned by rote repetition or with forgotten NLMs declined with longer retention intervals, the pairs with NLMs available were recalled correctly over 90% of the time even after a nine-day interval.

Even though the majority of studies reported in the literature support the usefulness of verbal mnemonics, there are studies which suggest that in some cases verbal mnemonics may have limited usefulness. Among those studies which investigate the role of NLMs, Adams and McIntyre

(1967) suggest the significance of remembering the NLMs formed during original learning. This study demonstrated that forgetting of NLMs produced even poorer recall than rote learning. The transfer hypothesis of NLMs was suggested to explain the finding. It was Adams and McIntyre's contention that NLMs are an integral part of the associative process as supported by the evidence that retention of NLMs and recall responses are strongly related. The associative strength for a pair is hypothesized to be derived from the strength of the NLM that is transferred to it. When forgetting processes eliminate the NLM at recall, the response loses the associative strength derived from the NLM and results in poor recall.

Time may be another important variable which limits the usefulness of verbal mnemonics. Schwartz (1969) did two experiments to investigate the effect of instructing subjects to use verbal mediatiors as compared with the effect of standard instructions on the acquisition of a single PA list. Recall was paced at two seconds in the first experiment and was untimed in the second one. It was found that instructing subjects to mediate facilitated performance when recall was untimed but not when it was paced at two seconds. The author suggests that this was due to the difficulty of utilizing mediators effectively with two-second recall intervals.

Usefulness of Imaginal Mnemonics

As with verbal mnemonics, there are a large number of studies which support the usefulness of imagery as a mnemonic in verbal learning and memory tasks.

Schnorr and Atkinson (1969) employed a within-subjects design to investigate visual imagery by instructing subjects to use imagery to remember half of the noun pairs and repetitions to remember the other half. It was found that the pairs studied by using imagery were better remembered than pairs studied by repetitions.

Rimm , Alexander and Biles (1969) conducted a study demonstrating the superior performance of subjects who were instructed to use imagery over control subjects with no imagery instructions. The imagery subjects were told to create a mental picture depicting both objects (which the words of the pairs represented) in some form of interaction. The control subjects were given either standard PA instructions or rote rehearsal. The results indicated that the imagery instructions produced performance which was superior to the control groups. Similar results were subsequently reported by Bower (1972). Further support for the usefulness of imagery is obtained from post hoc questionnaires. For example, Paivio, Yuille and Smythe (1966) found that learning scores were higher for pairs reportedly learned with the aid of imagery as compared to non-mediated pairs.

Other studies demonstrate the usefulness of imagery by using the "hook" system or the imagery rhyme technique. The "hook" system is usually employed in commercial mnemonics. Its general procedure is as follows: first of all, subjects memorize a highly overlearned list of common words and put them in a coded sequence. On subsequent learning of new list of words, subjects start to associate each new word with the appropriate word in the overlearned list by forming a mental image which depicts both an over-learned word and the new word in some form of interaction. When required to recall, subjects retrieve the new word from memory by retrieving the "hook" to which the new word is associated with. The retrieval of the "hook" is supposed to retrieve automatically the newly associated word. Berla and Persensky (1969) compared subjects who were trained in the use of a "hook" system with those who were trained by a traditional rote rehearsal method and tested the two groups on the total time required to learn a list of 20 concrete nouns. It was found that the mnemonically trained subjects required significantly less time to recall the list than did the rote-learned subjects.

The imagery rhyme technique is usually employed in serial learning. Subjects are instructed to learn a list of peg words which rhyme with numbers (e.g., one-bun, two-shoe, three-tree, ect.). After learning the list of peg words, they are given another list of words for retention test.

This list is learned by forming an interacting image of the peg word and the corresponding test word. On the retention test, the first peg word is remembered as bun since it rhymes with one and that the number-peg word list was previously overlearned. Remembering "bun" is supposed to retrieve the interacting image of the bun and the corresponding test word. A lot of studies investigating this method support its usefulness. To cite just a few, Bugelski, Kidd and Segmen (1968) used the imagery rhyme technique to compare an imagery group with two control groups. Presentation rates were also varied. One control group was taught the rhyme but not informed of its mnemonic function, while the other control group was given standard learning instructions. The data indicated the superiority of the imagery group, especially at the longer presentation time. Paivio (1968) suggests that although the Bulgelski et al., study was evidence for the effectiveness of the imagery rhyme technique, the contribution of the imagery component of the mnemonic instructions was left undetermined by their results, since the study did not include a rhyme control group that had been given mnemonic instructions without being told to use images. Paivio included in his study rhyme control subjects who were instructed to say to themselves rhyming words along with the words-to-be-remembered without reference to the use of imagery. The imagery subjects were told to form a mental image of the rhyme used and the word-to-be-remembered. In addition, a no

rhyme control group was added. The results indicated that mnemonic instructions without imagery had no beneficial effect. In fact, recall tended to be lower under the mnemonic than under the control condition. This study demonstrated that imagery was an important component of the rhyme technique.

Although there is ample evidence to support the usefulness of visual imagery, it should be mentioned here that the subjects used in the above studies were adults. The usefulness of imagery is not that clear-cut when it comes to the use of children as subjects.

Levin and Kaplan (1972) attempted to examine the imaginal facilitation of PA learning with the use of groups of sixth-graders who received visual imagery instructions (or regular instructions) to learn to associate pairs of pictures (or words). It was found that imagery instruction for picture pairs was more facilitative than imagery instruction for word pairs. The findings were interpreted in terms of one transformation versus two transformations on the part of the subjects. When pictures constitute the learning materials, the subject must relate the two pictured objects to create an interacting image. This involves one transformation which the subject has to perform. When word pairs constitute the learning materials, the subject has to perform two transformations. First, he must create a picture of each of the two objects, then he must relate the

two pictorial representations of the objects in some form of interaction. The authors suggest that the study limits the generalization of the facilitative effect of visual imagery when the subjects used in investigations are school children. That is, the facilitative effect is contingent upon the form in which stimulus materials (pictures or words) are presented.

In another study with children, Pressley and Levin (1977) examined the effect of presentation rate upon the efficacy of a visual imagery learning strategy. Children in grades two and six were presented a list of concrete noun pairs either at a six-second or a twelve-second rate, under either imagery instruction for the pairs or a no instruction condition. The list of noun pairs was composed of two pair types: pairs which were easy to use imagery to relate and pairs which were difficult to use imagery to relate, as determined from a previous norming study. It was found that at the six-second presentation rate, second-graders were able to benefit from the facilitative effect of imagery instruction with easy pairs, but not with difficult pairs. At the twelve-second presentation rate, they were able to use the imagery strategy equally well on both pair types. For the sixth-graders, they applied the imagery strategy equally well to both pair types at both presentation rates. The authors suggest that among younger children, the efficacy of imagery instructions may be situation-specific. That is, it may be influenced by factors such as the

particular items to be associated (easy or difficult to form interacting images) and presentation rate (fast or slow).

Efficacy of Mnemonic Devices: Verbal or Imaginal?

If we accept that there exists two types of mediations (verbal and imaginal), a relevant question which can be asked is that which of the two types of mediations is more effective for learning? Some studies comparing verbal and imaginal mediations have found verbal mediation to be superior. Milgran (1967) instructed children to learn a PA picture list by either verbal context (providing a sentence combining the stimulus and response items of the pair) or visual compound (showing a picture combining the stimulus and response items of the pair in some form of interaction). The results suggested that the verbal context was more facilitating than the visual compound in learning. Davidson and Adams (1970) also used picture pairs and children as subjects in their study. They found that use of a prepositional connective (e.g., the rope around the jar) was more effective than showing the pictures in interaction (e.g., an interacting picture of a rope put around a jar).

Other studies report the superiority of imaginal mediation. Rasen and Bartz (1968) compared the effect of imagery instructions, word instructions and no instructions on a PA learning task. The pairs were made up of nouns and /or their line drawings. It was found that imagery

instructions facilitated performance while the word instructions resulted in lower performance than a control group given no imagery instructions (standard PA instructions). Further support on the facilitating effect of imaginal mediation compared to verbal mediation is provided by Rimm, Alexander and Eiles (1969). In their study, one group was instructed to use imaginal mediation while another group was instructed to use verbal mediation. It was found that performance under verbal mediation was significantly lower than performance under imaginal mediation.

Still other studies suggest no difference between the efficacy of verbal and imaginal mediations. Davidson (1964) presented second-grade children with a PA task to assess the differential effectiveness of verbal and imaginal mediations. It was found that the two forms of mediations were equally effective. Yuille and Paivio (1968) also found that instructions to use verbal or imaginal mediation resulted in no differences in recall.

The inconsistent results reported above suggest that the question, which type of mediation is better may not be a very meaingful one. A more fruitful approach may be to ask which is a better mediator for what type of material and under what conditions of presentation.

Yarmey and Csapo (1968) report that instructions to use verbal or imaginal mediation were equally effective in

recall for concrete words but verbal mediation was superior in recall for abstract words. The authors suggest that verbal and imaginal mediations tend to promote difference in encoding of materials depending upon the stimulus attribute (i.e., concreteness or abstractness).

In connection with the concrete-abstract dimension, Paivio (1971) further hypothesizes differences in directionality of associations between verbal and imaginal mediations in PA learning. He states that visual imagery is specialized for parallel processing in the spatial sense. To the extent that associations involve imagery, either member of the pair will be equally effective as a cue for retrieval. On the other hand, verbal mnemonics are specialized for sequential processing. To the extent that word pairs are encoded verbally, the association will be directional. Since concrete items are presumably easier to evoke images, it follows that the more concrete the item pairs the more likely it is that there will be parallel processing. Conversely, the more abstract the items, the more likely it is that there will be sequential processing. Paivio's hypothesis of associative directionality was supported by Mondani and Battig (1973) who investigated the relationship between verbal and imaginal mnemonics and directinality of associations. For abstract words, it was found that forward recall was better than backword recall and there was more unidirectional recall for abstract than concrete words.

Paivio (1966) suggests that presentation rate may be another important variable. According to him, imaginal mediation may suffer at fast presentation rate when compared with verbal mediation since image arousal is slower than verbal association for both concrete and abstract words.

Theories of Imaginal Mnemonics: Mediation or Differentiation?

This section attempts to discuss and evaluate two major theoretical accounts of imagery in PA learning. These two theories are mediation theory and differentiation theory.

The two major advocates of mediation theory are Paivio who proposes a conceptual peg hypothesis and Bower who proposes a relational association hypothesis. In Paivio's conceptual peg hypothesis, the stimulus member of a pair is thought of as a "conceptual peg" the purpose of which is to "hook" the response member during learning trials to form a compound image or unit when the stimulus and response members are presented together. When the stimulus member is presented alone on recall, it serves as a peg for retrieval of the response member. Obviously, in Paivio's theory, the image-arousing capacity of the stimulus member is placed in a role of major importance. The reason is because only the stimulus member is presented on recall trials, it must serve as the cue that reinstates the compound image from which the response member can be retrieved. This hypothesis predicts

that the facilitating effect of imagery will be greater on the stimulus side than on the response side. Along a dimension of the image-arousing capacity of words, concrete words will elicit images more readily than abstract words. Thus, it would be expected that PA learning of words will be particularly facilitated when the stimulus word is concrete (see Paivio, 1969 and 1971 for a fuller discussion).

Perhaps it is Paivio who has done more than any other researcher to develop a theory to account for the role of imagery in PA learning and to conduct systematic and extensive research on it. Because of the significance of Paivio's work, some of his experimental findings will be discussed in greater detail.

Paivio (1965) varied concreteness and abstractness on the stimulus and response side of a pair. The results indicated that the facilitating effect of imagery is greater on the stimulus than on the response side. In the same experiment, the words were rated by the subjects on the ease with which they elicit images. It was found that concrete words were superior to abstract words in their capacity to elicit images. Other studies ruled out the possibility that the facilitating effect was atttributable solely to meaningfulness rather than imagery (Paivio and Madigan, 1968; Paivio, Smythe and Yuille, 1968; Paivio, Yuille and Smythe, 1966; Smythe and Paivio, 1968). Other source of evidence alsc supports Paivio's conceptual peg hypothesis.

Dilley and Paivio (1968) compared the effect of pictures and words on stimulus and response sides in PA learning with children as subjects. It was hypothesized that since pictures provide images more directly than words, they should facilitate learning and such facilitation should be greater on the stimulus than on the response side. The results supported this hypothesis.

Bower (1970) proposes a relational association hypothesis which is quite similar to Paivio's conceptual peg hypothesis. According to Bower, the positive effect of imagery is to strengthen the associative connection between stimulus and response of a pair. Visualizing the two items in some form of interaction increases such associative connection and thus facilitates retrieval of the response item when the stimulus item is presented alone on recall. In general, both Paivio and Bower emphasize the importance of forming an interaction between the stimulus and the response during learning trials. For Paivio, it is the formation of a compound image brought about by stimulus-elicited imagery. For Bower, it is the formation of a relational association which enhances the associative connection between the stimulus and the response members of a pair.

To test his hypothesis, Bower (1972) instructed two groups of subjects to use imagery in a PA learning task. One group was instructed to form an image joining the two

objects together in some form of interaction. The other group was instructed to form images of the two objects separately. It was found that the interaction group performed better than the "separation" group on recall. In addition, there was no significant difference between performance of the "separation" group and the repetition control group. Thus it seems that the associative connection between the stimulus and the response is an important component in imagery instruction.

Differentiation theory suggests that imagery functions in a manner such that it makes the pairs (or the stimuli) more differentiated or distinctive rather than acting as a mediator. Thus, increases in imagery are related to greater differentation among pairs or stimuli. The resulting learning differences are due to reduced interferences.

Dominowski and Gadlin (1968) propose a theory of stimulus differentiation and present evidence against the conceptual peg hypothesis. Since this is one of the few major studies which represents the differentiation interpretation, the experimental evidence will be discussed in some detail. In the first of three experiments, a comparison of the rate of PA learing was made with three different types of stimuli which represent three different points along an imagery-evoking dimension. The stimuli were pictures, object nouns (e.g., house, apple) and category nouns (e.g., dwelling, fruit), from fastest to slowest along

the imagery-evoking dimension. The results indicated that the three different stimuli produced different learning rates. Namely, pictures as stimuli were more facilitating than object nouns which in turn were more facilitating than category nouns. The results appeared to agree with the conceptual peg hypothesis (i.e., pictures elicit images easier than object nouns and category nouns. See Dilley and Paivio, 1968). However, an analysis of subjects' reported use of mediations showed that although more imaginal mediations were reported for pictures than for object nouns or category nouns, few imaginal mediations were reported even for pictures. The authors suggest that learning differences could be interpreted in other ways rather than attributing the differences to the differential use of the number of imaginal mediators.

A second experiment was conducted to test the difference between object nouns and category nouns as stimulus. It consisted of four groups of subjects. Two groups were given object nouns and two were given category nouns. In addition, one group given object nouns and one group given category nouns were also shown the appropriate picture inserted between the stimulus and response. The purpose was to test whether or not providing imaginal mediators by inserting a picture between the stimulus and the response would facilitate learning. The results indicated that the insertion of pictures did not facilitate learning. The authors suggest that increases in imagery are

associated with greater differentiation among stimuli which reduces intralist interference and facilitates learning.

A third experiment was conducted in which list learning was not involved. The same types of stimulus materials used in the first experiment were employed. A short-term memory procedure was used in order to test one pair at a time. The authors hypothesized that if differentiation was a major factor, then learning differences will be observed among the three types of stimulus materials only when lists are used. However, learning differences will not be observed when lists are not used. The results indicated that there were no learning differences which appeared to agree with the differentiation interpretation.

Although the experiments conducted by Dominowski and Gadlin appear to support a differentiation interpreation of the facilitating effect of imagery, their data should be interpreted with care. In their study, the response terms used were two-digit numbers. As suggested by Paivio (1971), it is possible that they would act like nonsense syllables, and not be able to produce object-images readily which could then be incorporated into compound images.

In a recent study, Tatum (1976) attempted to test the mediation and differentiation accounts of the stimulus imagery effect by manipulating stimulus imagery (high versus low) in a PA learing task. It was found that high stimulus imagery had higher facilitating effect on recall than low

stimulus imagery. However, stimulus recognition test indicated that the high-imagery stimuli were not recognized better than the low-imagery stimuli. The results were interpreted as a failure to support the differentiation interpretation and it was concluded that the mediation interpretation is a more plausible account of the effect of stimulus imagery in PA learning.

At present, although there is perhaps more evidence to support the mediational explanation of imagery effect, it has been pointed out by Paivio (1969) that imagery may function in several different ways. When the stimulus is concrete and the response is a meaningful word, a compound image can easily be formed. Here, imagery functions as a mediator. In other tasks, such as those in which visual images of the stimulus and response are more difficult to form (e.g., Dominowski and Gadlin's use of two-digit number as the response term), imagery may serve a non-mediational role such as differentiation.

Purpose of the Study

Characteristics of an Effective Imaginal Mnemonic: A New Angle of Investigation

Although there is little disagreement in the literature on the facilitating effect of instructing subjects to use imaginal mnemonics in PA learning tasks, attempts have been

made in recent years to specify the characteristics or qualities which can make imaginal mnemonics more effective as a mediator. Professional mnemonists (e.g., Lorayne, 1957; Lorayne and Lucas,1974) have long been strong advocates of the efficacy of mental images when formed in bizarre ways and have done a great deal to promote its use among the general public. However, experiments conducted in the laboratory have indicated that bizarre imagery may have no facilitating effect. This section reviews some of the empirical evidence.

Delin (1969) compared various characteristics of imagery mnemonic instructions by employing a cumulative design with the successive addition of such characteristics as activeness, vividness and bizarreness. It was found that except for bizarreness, learning increased with the completeness of mnemonic instructions. Delin suggests that the negative results obtained with bizarreness may be due to problems in defining it and also due to subjects' difficulties in forming bizarre images.

In another study, Collyer, Jonides and Bevan (1972) compared the relative facilitating effect of instructing subjects to use either common (plausible) imagery or bizarre (implausible) imagery strategy to learn noun-verb-noun triplets. The results indicated the superiority of common over bizarre images. Using a 'figural unity' interpretation, the authors suggest that the subjects who

were instructed to form bizarre imagery may produce images which were less complete and less detailed and thus resulted in inferior perfcrmance.

An initial study by Persensky and Senter (1970) indicated the positive effect of bizarre mental imagery as a mnemonic device in the learning of two serial verbal lists. This study, however, was criticized by Wollen, Weber and Lowry (1972) on the grounds that the demonstrated efficacy of bizarreness may be based on confounding this variable with the effective variable of interaction. An experiment was conducted to test this hypothesis. The results of which indicated that bizarreness had no positive effect upon recall performance. Interacting pictures produced higher performance compared to noninteracting pictures. The Wollen, et al., experiment was positively replicated by Senter and Hoffman (1976) who demonstrated that interaction was an important variabhle in imaginal mnemonic learning but bizarreness was not.

Other investigators suggest that training may be an important variable for bizarre imagery to be effective. Nappe and Wollen (1973) instructed subjects to form a common image for each of 24 noun pairs and a bizarre image for each of 24 other noun pairs. The results indicated that there was no significant difference between common and bizarre imagery instructions on recall performance. In fact, bizarre images required more time to form. The authors

speculate that if bizarreness is to be effective in any circumstances, subjects have to be highly trained in the techniques of forming bizarre images (as in the case with profesional mnemonists). Hauck, Walsh and Kroll (1976) conducted an experiment to determine the effects of practice which may contribute to superior recall for bizarre imagery. Their experiment was conducted in five sessions over a five-day period. The rationale was that practice or experience may differentially improve the use of bizarre imagery either by improving the quality of the bizarre images or by enhancing the interference among common images. It was found that there was no significant difference between recall performance of using bizarre images and using common images. The effect of training seemed to contribute to an increased speed of forming both bizarre and common images but the difference in speed still favored common images.

Perhaps the only study which indicates the positive effect of bizarre imagery is the one conducted by Andreoff and Yarmey (1976) who report that bizarreness of imagery facilitates associative recall, particulary delayed recall.

Although the majority of the studies which examine the role of bizarre imagery as a possible effective variable are not supportive, the issue is not yet closed. The writer contends that this is mainly due to the loosely defined usage of the term "bizarreness". Persensky and Senter (1970) did not give an explicit definition for bizarreness

which led to the confounding between 'grotesque distortion' and 'unusual interaction' (see Wollen, Weber and Lowry, 1972; Senter and Hoffman, 1976). Colleyer, Jonides and Bevan (1972) defined bizarreness as 'implausibility'. Andreoff and Yarmey (1976) did not elaborate on the definition of bizarreness.

The present study attempted to investigate the characteristics of an effective imaginal mediator by examining the dimension of functional versus nonfunctional interaction between two images and by equating functional imagery with a more natural type of imagery and nonfunctional imagery with a bizarre type of imagery. Paivio (1971) emphasizes that one of the dominant characteristics of imaginal mediation is its capacity for achieving integrated spatial organization of item information. Within the framework of the conceptual peg hypothesis in paired-associate learning, the emphasis is on the arousal of compound image by both members of a pair during the study trial, and the capacity of the stimulus member to reintegrate the compound on the recall trial. This conceptualization suggests that the degree or level of figural organization of the mediating image would be an important determinant of its effectiveness as a mediator. Epstein, Rock and Zuckerman (1960) found that paired-associate learning of picture pairs was facilitated when the pairs were presented in such a way that they could form good conceptual units. This finding provides evidence that

figural organization is an important feature of effective mediating image.

The rationale of the present study in equating functional imagery with a more natural type of imagery, and nonfunctional imagery with a bizarre type of imagery was based on the figural organization interpretation that a functinal type of interaction would promote a higher level of figural organization than a nonfunctional type of interaction and would result in better recall. Following the conceptual peg hypothesis, functional interaction emphasizes the use of the functional value of the stimulus member of the pair as a "peg" to form an interactive image with the response member. For example, the function of a pencil (stimulus member) is to write on a piece of paper (response member). Nonfunctional interaction involves the formation of an interactive image which does not employ the functional value of the stimulus member of the pair. Such an interactive image might be to visualize a pencil piercing through a piece of paper. It was hypothesized in the present study that instructions to form functional interactive images will produce better recall as compared to instructions to form nonfunctional interactive images.

Types of Stimulus Materials Used: Pictures versus Words

A second variable of interest in the present study was to compare the efficacy of pictures and words in a PA

learning task. A large number of research studies have been conducted to examine the relative effectivenss of these two kinds of stimulus materials in a variety of verbal learning tasks. In free-recall tasks, it has been reported that pictures are generally superior to words (Kaplan, Kaplan and Sampson, 1968; Paivio and Csapo, 1968; Paivio , Rogers and Smythe, 1968). Paivio (1971) suggests that the reason why pictures are better stimulus materials for free recall is because they are more vivid than words and can make a deep impression on memory. Other studies have shown that recognition memory for pictures is better than that for words (e.g., Jenkins, Neale and Dene, 1967; Shepard, 1967).

The superiority of pictures over words is often reported in PA learning studies. Since the present study employed a PA learning paradigm, more attention is given to some of these studies. Epstein, Rock and Zuckerman (1960) found that picture pairs had superior recall to word pairs. They suggest that this superiority was due to the relative ease of the pictures to form conceptual units which could combine the separate items into a new-whole. Paivio and Yarmey (1966), using adults as subjects, found that pictures facilitated learning as stimulus term but did not facilitate learning when used as response term. Dilley and Paivio (1968) extended the Paivio and Yarmey study to young children. The facilitative effects of pictures as stimulus terms were consistent with results previously obtained with adults. In addition, it was found that pictures hindered

learning when used as response terms. The finding was interpreted as indicative of children's difficulty to transfer the memory image into verbal form in order to produce the correct response. Short (1975) studied the age trend (sixth-graders, ninth-graders and adults) and the relative efficacy of using either picture pairs or noun pairs as stimulus materials. It was found that picture pairs produced facilitating effect on sixth-grade subjects, but there was no difference between the two forms of stimulus presentation for adult learning. The 'no difference' finding in adult learning was interpreted as the older subjects' increased ability to process verbal information which acts as a competing mechanism to obscure the relative efficacy of either picture or noun pairs.

It seems that those studies which compare the efficacy of picture and word pairs in various kinds of verbal learning tasks have usually found picture pairs superior. Within a PA learning paradigm, the present study hypothesized that pictorial stimuli will be easier to retrieve than word (concrete noun) stimuli and will result in higher performance on recall.

Imagery and Long-Term Retention

A third variable of interest in the present study was to examine the effect of imagery over a relatively long time interval. There is a scarcity of experimental evidence

relevant to this question and the evidence available is conflicting.

Groninger (1971) and Schnoror and Atkinson (1969) report the facilitating effect of imagery as compared with rote repetition over an extended period of time (one week). Begg (1973) proposes an integration hypothesis to account for imaginal facilitation of performance on recall. This hypothesis states that imagery is an effective variable in recall because images aroused by the verbal stimuli can be readily integrated into complex imaginal units. Recall of one component of the unit would lead to retrieval of the rest of the unit. Begg and Robertson (1973) conducted a study to examine the effect of integrative images upon long-term retention. It was found that instructions to use integrative images, particularly in learning concrete rather than abstract nouns, facilitated retrieval over a period of seventy-two hours.

Negative results have been reported by other investigators on the relationship between imagery and long-term retention. Contrary to the Begg and Robertson findings, Butter (1970) found that PA nouns of high imagery value facilitated immediate recall but resulted in poor ultimate recall (two-day period). The reverse was true for PA nouns of low imagery value. Similar findings were reported by Palermo (1970) who used children as subjects. It was found that the recall of responses associated with

high-imagery words decreased with time, but there was a significant increase in recall of responses associated with low-imagery words after a period of two days.

Postman and Burns (1973) investigated the effects of imagery value of stimuli and responses on the long-term retention of lists of PAs. After an interval of one week, it was found that when responses had a high imagery value (concrete nouns), the characteristic of the stimuli became crucial for retention. That is, when the responses were concrete, recall was better with stimuli which had low imagery value than those which had high imagery value. The results were used to interpret that high facilitation in encoding (acquisition) does not necessarily mean the same degree of facilitation in decoding (retention, particularly over an extended period of time). That is, when both the stimulus and response members have high imagery values, the association can easily be encoded in the form of a compound image. Over a period of time, it is possible that the compound image cannot retain the same degree of intactness. The result is a decoding problem when required to translate the response component into its appropriate verbal equivalent during recall. On the other hand, when the stimulus is an abstract word, the encoding operation is likely to encompass a verbal component in addition to an imaginal component. The problem which is particular to a purely encoding operation (i.e., loss of intactness) does not apply here because it is assumed to involve some verbal

mediation. The positive effect of imagery on long-term retention reported by Begg and Robertson (1973) was criticized by Postman (1974) on methodological grounds. That is, the study failed to equate the degree of learning between abstract and concrete pairs before assessing their relationships with long-term retention.

In the face of the scarcity of experimental evidence and contradictory answers to the relationship between imagery and long-term memory, the null hypothesis was proposed in the present study. Putting aside any theoretical persuasions, it is of course unrealistic to assume that the same high level of retention can be maintained over an extended period of time (say, one week). The present study merely aimed at investigating the extent of decline of recall over a period of time which, hopefully, can contribute to clarifying the role of imagery in long-term memory.

To recapitulate the hypotheses tested in this study:

Hypothesis one stated that instructions to form frunctional interactive images will produce better perfomrance on recall than instructions to form nonfunctional interactive images.

Hypothesis two stated that pictorial stimuli will be easier to retrieve than word (concrete noun) stimuli and will produce better retrieval.

The null hypothesis was proposed with regard to the relationship between imagery and long-term memory.

Chapter 2

METHOD

Research Design

This study employed a 2x2x2 factorial design. Cognitive strategy was the first factor. It consisted of functional instructions and nonfunctional instructions as levels of this factor. Stimulus material was the second factor. Picture pairs and word pairs were levels of this factor. Retention interval was the third factor. Immediate and delayed (one week) recall were levels of this factor. The dependent measure was a one-trial standard PA learning recall task.

Subjects

Eight groups of students (a total of seventy-one) from two introductory educational psychology courses at the University of Alberta were used as subjects. The eight groups of subjects were assigned randomly to each of the eight experimental conditions as required by a 2x2x2 factorial design in the present study. The cell sizes were unequal. The number of subjects ranged from seven to eleven in each of the eight cells.

Materials

This study employed two kinds of stimulus materials. The first kind consisted of thirty-six pairs of pictures taken from primer work books for first-grade children. The pictures were familiar object nouns (chair, flower, umbrella, ect.). These nouns appear in the Thorndike-Lorge (1944) list with counts from A(50) to AA (100). The pictures were photographed onto transparencies and constituted the pairs to be learned. These types of pictures have been used in previous research studies (Davidson, 1964; Short, 1975). The thirty-six left-hand pictures of each PA were also photographed onto transparencies. They constituted the stimuli for the retrieval test. (See Appendix A for the paired-associate pictures used.)

The second kind of stimulus material consisted of thirty-six pairs of nouns which corresponded to the above thirty-six picture pairs. They were photographed onto transparencies and constituted the pairs to be learned. The thirty-six left-hand nouns of each PA were also photographed onto transparencies. They constituted the stimuli for the retrieval test. (See Appendix B for the paired-associate noun list.)

A total of one hundred and forty-four slides were used in this study.

Apparatus

A Kodak Carousel automatic slide projector was used in this study to present the PA learning materials (transparencies described earlier). The time was set for five seconds between presentation of consecutive PA slides. A constant rate of five seconds is thought to be appropriate for image formation (Paivio, 1967). In the retrieval test, the time was set at a ten-second presentation rate. This rate has been used and regarded as optimal by Davidson and Adams (1970) and Short (1975) for retrieval of response. In addition to the slide projector, an overhead projector and transparencies were used for the purpose of training subjects to use the appropriate type of cognitive strategy as required in the study (i.e., formation of functional or nonfunctional interactive images).

For the retrieval test, subjects wrote down their responses on a two-page response booklet which was numbered from 1 to 36. They were also asked to put down their names and the appropriate experimental condition on the booklets.

Procedure

General Procedure for All Immediate-Recall Experimental Conditions

The study was conducted in a group-testing situation. First of all, subjects were briefly informed of the nature of the experiment and they were subsequently trained to use the appropriate cognitive strategy in their particular experimental condition. They were then shown thirty-six PA slides (pictures or nouns) which were randomly assorted and presented at a constant rate of five seconds. The slides were projected onto a screen which every subject could see clearly.

Following the presentation of the PA learning materials, a retrieval test was given to the subjects. Thirty-six slides which contained the left-hand stimuli (pictures or nouns) of the previously shown PA slides were presented. These retrieval stimuli were randomly ordered with regard to the initial presentation but the order remained the same in each of the eight experimental conditions. The retrieval slides were presented at a constant rate of ten seconds and the subjects were asked to write down the appropriate response on the booklet while the slides were on the screen.

General Procedure for All Delayed-Recall Experimental Conditions

The initial procedures were the same as those used in the immediate-recall experimental conditions (see the first paragraph of the previous section). Except that following the presentation of the PA learning materials, instead of giving a retrieval test, the experimenter chatted with the subjects about the experiment for a few minutes and left the classroom. The subjects were not informed that there was to be a retrieval test afterwards. The reason for not providing any information about the test was to minimize the possibility of rehearsal effects which might confound the variables under investigation.

One week later, the experimenter appeared in the same classroom. Those students who did not participate in the first part of the experiment in the previous week were excused. The qualified subjects were briefly reminded of the nature of the experiment and the cognitive strategy they had to use. Then a retrieval test was given (following the procedure for the immediate-recall task).

Procedure for Specific Experimental Conditions

Experimental Conditions A and E : PA pictures with instructions to form nonfunctional interactive images. Immediate recall (Condition A) and delayed recall (Condition E). (See Appendix C for instructions.)

In Condition A, subjects were instructed to form a mental image joining the PA pictures shown on the screen in some kind of nonfunctional interaction. Three training examples were provided by using an overhead projector . For instance, a picture of a sharp pencil and a piece of paper were shown in a PA manner in a transparency. The next transparency showed a picture of the sharp pencil piercing through the piece of paper like an arrow as an example of the kind of nonfunctional interactive image the subjects were required to form (see Appendix D). After asking the subjects if they each understood what he was expected to do, the experimenter presented thirty-six PA pictures and the rest of the procedure followed the same sequence as described in the General Procedure for All Immediate-Recall Experimental Conditions.

In Condition E, the same procedure used in Condition A was followed. The retrieval test, however, was given one week after the initial presentation.

Experimental Condition B and F : PA words with instructions to form nonfunctional interactive images. Immediate recall (Condition B) and delayed recall (Condition F). (See Appendix C for instructions.)

In Condition B, subjects were shown pairs of words. They were asked to memorize each of the pairs by conjuring up a mental image for each of the words and to use these two images to form a nonfunctional interactive image. A possible example of how they might do this was shown on the overhead projector. First, the words 'pencil' and 'paper' were shown as a PA unit. Then a picture of the pencil piercing through the piece of paper was shown. Other similar examples were shown in the same manner. For example, for the word pair 'bat' and 'ball', they were asked to imagine the bat standing on top of the ball. For the word pair 'jug' and 'goldfish', they were asked to imagine a giant goldfish swallowing the jug (see Appendix D). After showing the examples and asking the subjects if they each understood what he was expected to do, the experimenter presented thirty-six PA words and the rest of the procedure followed the same sequence as described in the General Procedure for All Immediate-Recall Experimental Conditions.

In Condition F, the same procedure used in Condition B was followed. The retrieval test, however, was given one week after the initial presentation.

Experimental Conditions C and G : PA pictures with instructions to form functional interactive images. Immediate recall (Condition C) and delayed recall (Condition G). (See Appendix C for instructions.)

In Condition C, subjects were shown pairs of pictures. They were instructed to use the possible dominant function of the left-hand picture to form a functional interactive image with the right-hand picture. Three training examples were provided by using an overhead projector. For instance, a picture of a pencil and a piece of paper was shown in a PA manner in a transparency. The next transparency showed a picture of the pencil lying on top of the piece of paper (for writing or drawing) an an example of the kind of functional interactive image the subjects were required to form (see Appendix D). After asking the subjects if they each understood what he was expected to do, the experimenter presented thirty-six PA pictures and the rest of the procedure followed the same sequence as described in the General Procedure for All Immediate-Recall Experimental Conditions.

In Condition G, the same procedure used in Condition C was followed. The retrieval test, however, was given one week after the initial presentation.

Experimental Conditions D and H : PA words with instructions to form functional interactive images. Immediate recall (Condition D) and delayed recall (Condition H). (See Appendix C for instructions.)

In Condition D, subjects were shown pairs of words. They were asked to memorize each of the pairs by conjuring up a mental image for each of the words and to employ the possible dominant function of the left-hand image to form a functinal interactive image with the right-hand image. A possible example of how they might do this was shown on the overhead projector. First, the words 'pencil' and 'paper' were shown as a PA unit. Then a picture of the pencil lying on top of the piece of paper was shown. Other similar examples were shown in the same manner. That is, for the word pair 'bat' and 'ball' they were asked to imagine the bat hitting the ball. For the word pair 'jug' and 'goldfish', they were asked to image the goldfish swimming in the jug of water (see Appendix D). After showing the examples and asking the subjects if they each understood what he was expected to do, the experimenter presented thirty-six PA words and the rest of the procedure followed the same sequence as described in the General Procedure for All Immediate-Recall Experimental Conditions.

In Condition H, the same procedure used in Condition D was followed. The retrieval test, however, was given one week after the initial presentation.

Chapter 3

RESULTS AND DISCUSSION

Results

Table 1 and Figure 1 give the mean number of correct response for each of the eight experimental conditions in this study.

A 2x2x2 analysis of variance was conducted on the data. This analysis involved three factors each of which had two levels. The three factors were (1) cognitive strategy (functional versus nonfunctional), (2) stimulus material (picture pairs versus word pairs), (3) retention interval (immediate versus delayed recall). Table 2 shows the summary table of this analysis.

As indicated by the analysis of variance, the main effects of stimulus material and retention interval were significant ($F=6.09$, $df=1/63$, $p<.05$; $F=139.52$, $df=1/63$, $p<.001$), but the main effect of cognitive strategy did not approach significance ($F=0.81$, $df=1/63$). The first order interactions of cognitive strategy and stimulus material, cognitive strategy and retention interval, stimulus material and retention interval, and the second order interaction of cognitive strategy, stimulus material and retention interval were all insignificant.

Table 1

Means and Standard Deviations of Recall Scores over
Two Cognitive Strategies x Two Kinds of Stimulus Materials
as a Function of Retention Interval

Retention Interval	Stimulus Materials	Cognitive Strategies					
		Functional			Nonfunctional		
		$\bar{X}$	S.D.	n	$\bar{X}$	S.D.	n
Short-Term	Picture	20.78	7.45	9	18.57	6.43	7
	Word	17.11	5.04	9	13.64	9.34	11
Long-Term	Picture	2.86	1.57	7	3.5	2.55	10
	Word	0.88	0.83	8	1.2	1.23	10

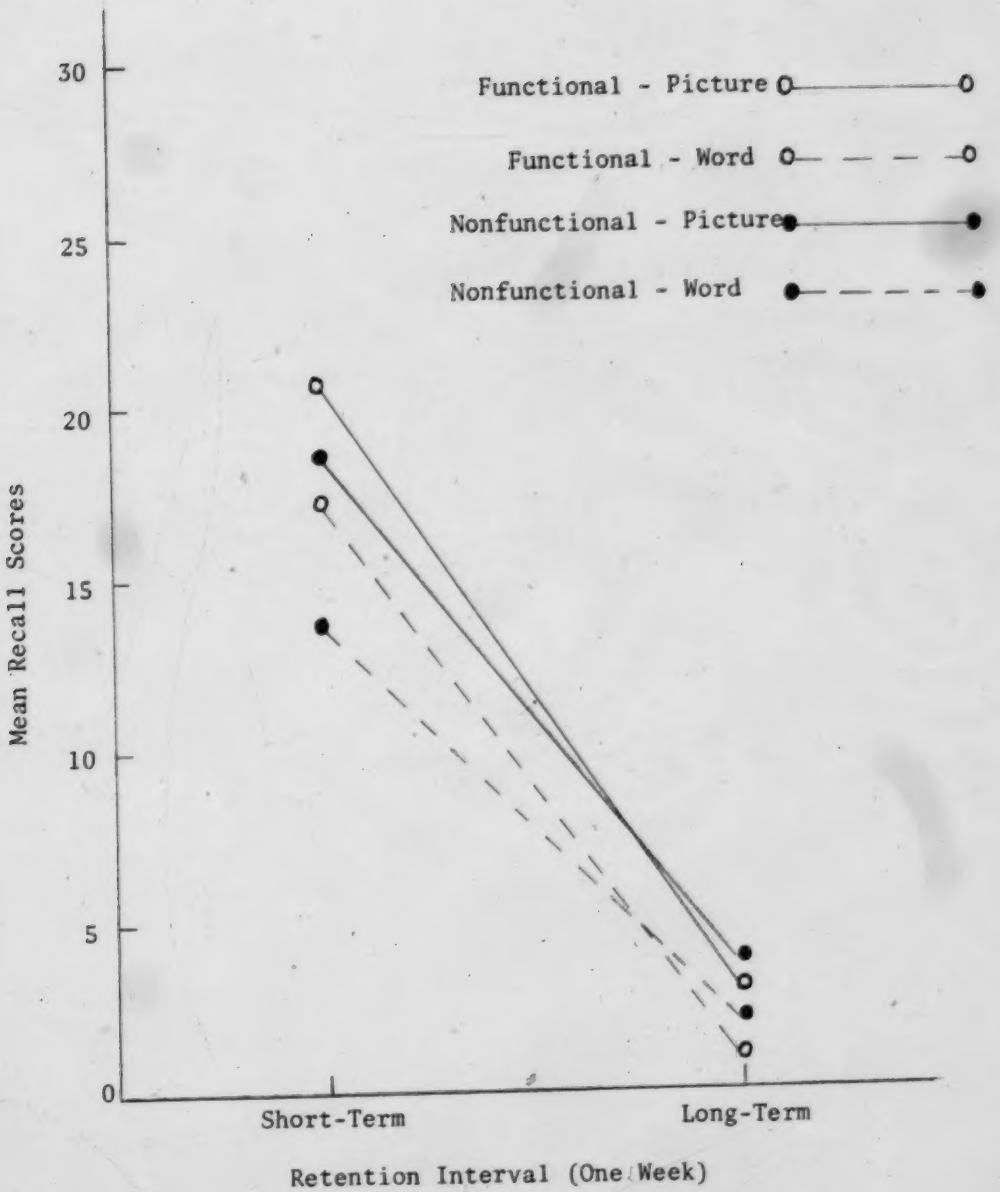

Figure 1. Mean Recall Scores over Two Cognitive Strategies x Two Kinds of Stimulus Materials as a Function of Retention Interval

Table 2

Analysis of Variance Summary Table

Source	df	MS	F	p
Cognitive Strategies	1	24.05	0.82	n.s.
Stimulus Materials	1	179.68	6.09	.01
Retention Interval	1	4115.96	139.52	.0
Strategies x Stimulus	1	2.72	0.09	n.s.
Strategies x Retention	1	47.85	1.62	n.s.
Stimulus x Retention	1	20.19	0.68	n.s.
Strategies x Stimulus x Retention	1	0.98	0.03	n.s.
Total	63			

N = 71

Discussion

The following discussion is centered on the hypotheses tested in the present study. The first hypothesis stated that instructions to form functional interactive images will have better performance on retrieval than instructions to form nonfunctional interactive images. The second hypothesis stated that picture pairs as stimulus material will produce better retrieval than word pairs as stimulus material. The null hypothesis was proposed with regard to the performance between immediate and delayed recall. The results are discussed as follows:

The first hypothesis was not supported. There was no significant difference between the two kinds of cognitive strategies with regard to recall performance. To recapitulate previous discussion on bizarre imagery, the majority of the studies report that bizarreness is an ineffective variable in improving the quality of imagery. A study by Paivio and Yuille (1969) appears to be relevant in explaining the 'no difference' finding of the present study. The Paivio and Yuille study investigated the hypothesis that subjects instructed to use rote repetition to learn PA material would abandon this instructional set over trials because of its inefficiency for the type of materials being learned. The hypothesis was investigated by using a trial-by-trial probe of strategies employed in learning the materials. It was found that subjects instructed to use

rote repetition reported frequent use of repetition on trial 1, but this reported use decreased sharply with the correspondent spontaneous use of some kind of interactive imagery on subsequent trials. The present study hypothesized that nonfunctinal strategy to form images, like bizarre strategy, is an ineffective variable. The 'no difference' finding can be interpreted in terms of the Paivio and Yuille hypothesis that because of the ineffectiveness of forming nonfunctional images, subjects quickly abandoned this strategy and employed a more 'natural' kind of strategy to form images which resulted in comparable but not necessarily better performance as comapred with subjects who were instructed to form functional images.

The second hypothesis was supported ($p<.05$). The superiority of picture pairs over word pairs is often reported on PA learning tasks (e.g., Dilley and Paivio, 1968; Epstein, Rock and Zuckerman, 1960; Paivio and Yarmey, 1966). The finding of the present study appeared to be in accord with the liternature on comparision betweeen the use of picture pairs and word pairs in PA learning.

Rohwer, Lynch, Levin and Suzuki (1967) suggest that the superiority of material in pictorial form over material in printed form may have some practical implications in school settings. According to them, the most direct implicaation of the demonstrated superiority of the pictorial mode is to

convert the relevant curricular materials from their presently available printed form to equivalent pictorial form. This conversion, however, is not problem-free. First, changing curricular materials to a pictorial form may result in considerable resistance from the public. Secondly, generalization of the findings should be restricted to those kinds of school learning tasks that are consistent with the PA learning paradigm. Thus, Rohwer et al., suggest that learners can be trained to make "covert pictorial responses" to printed materials. If such a training program is possible, it would both avoid the difficulties of reconstructing presently available curricular materials and allow learners to engage in efficient learning without necessarily taking into account the characteristics of the content they are required to learn (e.g., PA learning tasks).

With regard to the third variable of interest in the present study, the time factor was significant ($p<.001$) and the null hypothesis was rejected. To reiterate briefly previous discussion on the relationship between imagery and long-term retention, despite the scarcity of experimental evidence available, there exists two opposing interpretations of such a relationship. On the one hand, Begg's integration hypothesis (Begg, 1973; Begg and Robertson, 1973) suggests that imagery has positive effects to enhance long-term retention because images aroused by verbal stimuli can be readily integrated into complex

imaginal units. Recall of one component of the unit could retrieve the rest of the unit. On the other hand, Postman suggests the differential effects of imagery in encoding and deconding processes. The high facilitation in encoding (which is based on high imagery values of both the stimulus and response members of the pair) does not necessarily mean the same degree of facilitation in decoding (as a result of the difficulties of retrieving the response component of the compound image formed and translating it into the appropriate verbal equivalent). The present study employed PA materials with high imagery value and obtained similar results as those reported by Postman (Postman, 1974; Postman and Burns, 1973). The drastic decline of performance between the two time intervals poses some problems with regard to the possible practical use of imagery as a mnemonic device for long-term memory

Chapter 4

SUMMARY AND CONCLUSIONS

The purpose of this study was threefold: (1) To compare two kinds of imaginal strategies in a PA learning task. (2) To examine the relative effectivenss of picture pairs and noun pairs as stimulus materials. (3) To investigate recall peformance as a function of time.

The hypotheses tested in this study were: (1) The use of a functional type of imaginal strategy will facilitate retrieval more than a nonfunctional type. (2) Picture pairs as stimulus materials will produce better retrieval than noun pairs. (3) The null hypothesis was proposed with regard to the relationship between retrieval and retention interval.

This study employed a 2x2x2 factorial design. Subjects were eight groups of university students randomly assigned to one of the eight experimental conditions (N=71).

Two kinds of stimulus materials were used in this study.

1. Slides of thirty-six PA pictures of familiar objects were used for the learning task. Another thirty-six slides showing left-hand pictures of the thirty-six PAs were used for the retrieval task.

2. Slides of thirty-six PA nouns which corresponded to the thirty-six picture pairs were used for the learning task. Another thirty-six slides showing left-hand nouns of the thirty-six PAs were used for the retrieval task.

A total of one hundred and forty-four slides were used in this study.

This study was conducted in a group-testing situation. Subjects were required to learn thirty-six PAs, each pair presented at a rate of five seconds. For the immediate-recall subjects, they were required to make responses for each of the thirty-six retrieval stimuli following the learning trial. For the delayed-recall subjects, the retrieval task was given after one week. The retrieval stimuli were presented at a constant ten-second rate.

A three-way analysis of variance was used to analyze the data. It was found that instructions to use functional imaginal mediation was no more facilitating to retrieval than those to use nonfunctional imaginal mediation. Picture pairs as stimulus materials were more facilitating to retrieval than noun pairs. The decline of retrieval performance after a period of one week was drastic.

The data were interpreted as follows:

1. Subjects do not always follow the kind of cognitive strategy they are instructed to use in a PA learning task.

Especially the kind of strategy which is ineffective for the type of materials being learned.

2. In accord with previous findings, picture pairs are more facilitating than noun pairs as stimulus materials. Some educational implications are considered in terms of the superiority of the pictorial mode of representation in PA learning.

3. The drastic decline of retrieval performance after one week poses some problems with regard to the use of a pure form of imaginal mediation as a mnemonic device for long-term memory.

Limitations of the Study

Two points should be mentioned with regard to the limitations of the present study.

Short (1975) suggests that one of the problems of imagery research is that this cognitive process can only be inferred from observations of subjects' differences in behavior before and after experimental treatment. It cannot be observed directly. This suggestion is relevant to one of the limitations of the present study in the way that it was difficult (or impossible) to be sure that subjects would follow exactly the kind of cognitive strategy as instructed to use. As discussed previously, the 'no difference' finding between the use of functional and nonfunctional

imaginal strategies suggested the possibility of subjects' switch of strategy from an ineffective to a more effective one. Future studies which investigate the use of particular instructional sets in imaginal mediation should strengthen this variable by making the switch of strategy (or instructional set) more difficult for the subjects. A study by Paivio and Foth (1970) suggests how this might be done. In their study, a procedure was used that literally forced subjects to generate a particular kind of mediation for a given pair in PA learning. That is, when instructed to use an imaginal mediator, the subjects were required to generate (mentally) an image integrating both members of a pair and then to write the "image" on paper. The subjects were informed that the quality of the drawing was not important. Similarly, when instructed to use a verbal mediator, the subjects were required to think of a mediating phrase or sentence and to write it down.

The second limitation of the present study lied in the stimulus materials used. Among the thirty-six paired-associates used, not all stimulus members of the pairs suggested a conspicuous dominant function. Some of the stimulus members had high functional value as conceptual pegs to "hook" the response members (e.g., hand, box, umbrella) while some of them had rather low functional value (e.g., peanut, bear, saltshaker). It was hypothesized that the formation of functional interactive images would promote a higher level of figural organization than the formation of

nonfunctional ones. The low functional value of a number of the stimulus members might negate the advantage of functional strategy over the nonfunctinal one.

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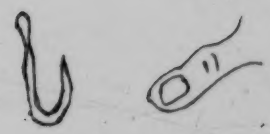
APPENDIX A

1. 

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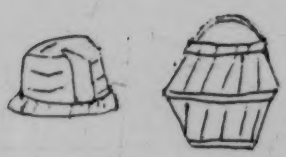
3. 

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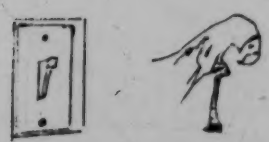
5. 

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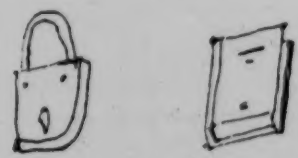
7. 

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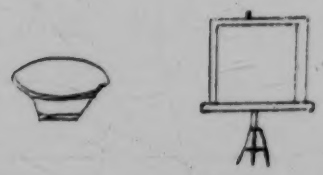
9. 

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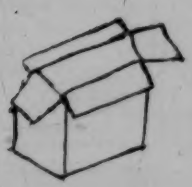
17. 

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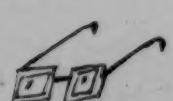
23. 

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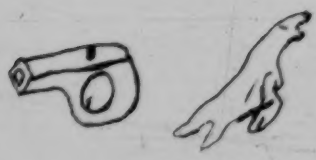
27. 

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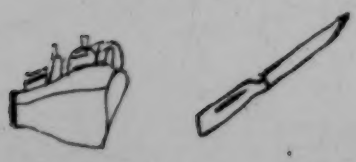
30. 

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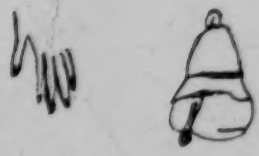
32. 

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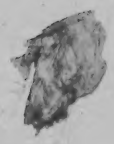
APPENDIX B

Randomized presentation order of paired-associate slide transparencies (learning trial) for both the pictorial and verbal stimulus conditions.

1.	HOOK	THUMB	19.	TANK	FENCE
2.	JAR	ROPE	20.	SALTSHAKER	PUMP
3.	CAKE	BARREL	21.	MAILBOX	SKATE
4.	BUTTERFLY	TOP	22.	UMBRELLA	FLOWER
5.	LIGHTSWITCH	PARROT	23.	BOW	GLASSES
6.	SHOVEL	TELEVISION	24.	CHAIN	FEATHER
7.	LOCK	BOOK	25.	SCISSORS	HAT
8.	IRON	SCALES	26.	COMPASS	RAT
9.	BOWL	SCREEN	27.	WHISTLE	SEALION
10.	LAMP	PEN	28.	FAN	BARN
11.	TEAKETTEL	SACK	29.	PEANUT	MOON
12.	CANDLE	KEY	30.	BOAT	NAILFILE
13.	COW	DRESS	31.	BAT	AX
14.	PICTURE	BRUSH	32.	HAND	BELL
15.	NAILS	CHAIR	33.	SLIDE	BUTTON
16.	CAGE	TIE	34.	DOCTOR	PIPE
17.	BOX	RING	35.	RABBIT	TRUMPET
18.	CARD	BLOCK	36.	BEAR	DOLLAR

Randomized presentation order of the left-hand stimulus slide transparencies (retrieval test) for both the pictorial and verbal stimulus conditions.



1. WHISTLE
2. BAT
3. SALTSHAKER
4. PICTURE
5. HAND
6. PEANUT
7. CAGE
8. TEAKETTLE
9. BOAT
10. IRON
11. RABBIT
12. COMPASS
13. BOX
14. NAILS
15. UMBRELLA
16. SHOVEL
17. MAILBOX
18. LIGHTSWITCH
19. SCISSORS
20. DOCTOR
21. CHAIN
22. BOWL
23. BOW
24. CANDLE
25. BUTTERFLY
26. LAMP
27. SLIDE
28. TANK
29. BEAR
30. CARD
31. LOCK
32. FAN
33. CAKE
34. HOOK
35. COW
36. JAR

APPENDIX C

Instructions---Conditions A and E

For both Conditions : Please listen carefully to these instructions. In this experiment I will show you pairs of pictures on the screen to see how good your memory is. You must look at them and try to remember them as best you can. There will be quite a lot so do not get worried, just relax and do the best you can.

I am going to show you a series of pictures in pairs (show transparencies). Your task is to remember which pictrures go together so that you will be able to recall the right hand picture of each pair when you are shown only the left hand picture (cover up right hand pictures).

In this experiment, I would like you to try one particular method of learhing the pairs. This is the method of fomring nonfunctional, unusual images. For each picture pair you are shown, you should form an image in your mind joining the two pictures in each pair in a nonfunctional, unusual way (show transparencies). It is extremely important that you follow the instructions to the best of your ability. When you see the pictures in pairs I want you to use this methcd and no other.

I will show you 36 pairs of pictures presented one pair at a time. You will have 5 seconds to learn each pair. Look at each pair carefully and remember to form an image in

your mind joining the two pictures in a nonfunctional, unusual way. At the end of 5 seconds the next pair will automatically be presented.

Addition for Condition A : A retention test will follow after these picture pairs have been shown. That is, I will show you 36 slides with just the left hand picture of each pair and you will have 10 seconds to write down the correct response in the booklet I have provided. Please note that the left hand pictures presented to you in the retention test will not be in exactly the same order as they appeared in the learning trial.

Addition for Condition E : I hope you still remember what I told you last week that the aim of the experiment is to find out how good your memory is by showing you pairs of pictures on the screen. Now I would like to give you a retention test. I will show you 36 slides with just the left hand pictures of each pair and you will have 10 seconds to write down the correct response in the booklet I have provided. Please note that the left hand pictures presented to you in this retention test will not be in exactly the same order as they appeared in the learning trial last week.

Instructions---Conditions B and F

For both Conditions : Please listen carefully to these instructions. In this experiment I will show you pairs of words on the screen to see how good your memory is. You must look at them and try to remember them as best you can. There will be quite a lot so do not get worried, just relax and do the best you can.

I am going to show you a series of words in pairs (show transparencies). Your task is to remember which words go together so that you will be able to recall the right hand word of each pair when you are shown only the left hand word (cover up right hand words).

In this experiment, I would like you to try one particular method of learning the pairs. This is the method of forming nonfunctinal, unusual images. For each word pair you are shown, you should conjure up an image in your mind of what each word means to you and then form an image joining the two images together in a nonfunctional, unusual way (show transparencies). It is extremely important that you follow the instructions to the best of your ability. When you seen the words in pairs, I want you to use this method and no other.

I will show you 36 pairs of words presented one pair at a time. You will have 5 seconds to learn each pair. Look at each pair carefully and quickly create the image in your

mind of each word's meaning to you and the nonfunctional, unusual image which joins the two images together. At the end of 5 seconds, the next pair will automatically be presented.

Addition for Condition B : A retention test will follow after these word pairs have been shown. That is, I will show you 36 slides with just the left hand word of each pair and you will have 10 seconds to write down the correct response in the booklet I have provided. Please note that the left hand words presented to you in the retention test will not be in exactly the same order as they appeared in the learning trial.

Addition for Condition F : I hope you still remember what I told you last week that the aim of the experiment is to find out how good your memory is by showing you pairs of words on the screen. Now I would like to give you a retention test. I will show you 36 slides with just the left hand words of each pair and you will have 10 seconds to write down the correct response in the booklet I have provided. Please note that the left hand words presented to you in this retention test will not be in exactly the same order as they appeared in the learning trial last week.

Instructions---Conditions C and G

For both Conditions : Please listen carefully to these instructions. In this experiment I will show you pairs of pictures on the screen to see how good your memory is. You must look at them and try to remember them as best you can. There will be quite a lot so do not get worried, just relax and do the best you can.

I am going tc show you a series of pictures in pairs (show transparencies). Your task is to remember which pictures go together so that you will be able to recall the right hand picture of each pair when you are shown only the left hand picture (cover up right hand pictures).

In this experiment, I would like you to try one particular method of learning the pairs. This is the method of forming functional images. For each picture pair you are shown, the left hand picture suggests a dominant function. You should use that dominant function to create an interacting image with the right hand picture (show transparencies). It is extremely important that you follow the instructions to the best of your ability. When you see the pictures in pairs, I want you to use this method and no other.

I will show you 36 pairs of pictures presented one pair at a time. You will have 5 seconds to learn each pair. Look at each pair carefully and remember to use the dominant

function of the left hand picture to create an interacting image with the right hand picture. At the end of 5 seconds the next pair will automatically be presented.

Addition for Condition C : A retention test will follow after these picture pairs have been shown. That is, I will show you 36 slides with just the left hand picture of each pair and you will have 10 seconds to write down the correct response in the booklet I have provided. Please note that the left hand pictures presented to you in the retention test will not be in exactly the same order as they appeared in the learning trial.

Addition for Condition G : I hope you still remember what I told you last week that the aim of the experiment is to find out how good your memory is by showing you pairs of pictures on the screen. Now I would like to give you a retention test. I will show you 36 slides with just the left hand pictures of each pair and you will have 10 seconds to write down the correct response in the booklet I have provided. Please note that the left hand pictures presented to you in this retention test will not be in exactly the same order as they appeared in the learning trial last week.

Instructions---Conditions D and H

For both Conditions : Please listen carefully to these instructions. In this experiment I will show you pairs of words on the screen to see how good your memory is. You must look at them and try to remember them as best you can. There will be quite a lot so do not get worried, just relax and do the best you can.

I am going to show you a series of words in pairs (show transparencies). Your task is to remember which words go together so that you will be able to recall the right hand word of each pair when you are shown only the left hand word (cover up right hand words).

In this experiment, I would like you to try one particular method of learning the pairs. This is the method of forming functional images. For each word pair you are shown, the left hand word suggests a dominant function. You should conjure up an image in your mind of what each word means to you and use the dominant function of the left hand image to create an interacting image with the right hand image (show transparencies). It is extremely important that you follow the instructions to the best of your ability. When you see the words in pairs, I want you to use this method and no other.

I will show you 36 pairs of words presented one pair at a time. You will have 5 seconds to learn each pair. Look

at each pair carefully and quickly create the image in your mind of each word's meaning to you and use the dominant function of the left hand image to create an interacting image with the right hand image. At the end of 5 seconds, the next pair will automatically be presented.

Addition for Condition D : A retention test will follow after these word pairs have been shown. That is, I will show you 36 slides with just the left hand word of each pair and you will have 10 seconds to write down the correct response in the booklet I have provided. Please note that the left hand words presented to you in the retention test will not be in exactly the same order as they appeared in the learning trial.

Addition for Condition H : I hope you still remember what I told you last week that the aim of the experiment is to find out how good your memory is by showing you pairs of words on the screen. Now I would like to give you a retention test. I will show you 36 slides with just the left hand words of each pair and you will have 10 seconds to write down the correct response in the booklet I have provided. Please note that the left hand words presented to you in this retention test will not be in exactly the same order as they appeared in the learning trial last week.

APPENDIX D

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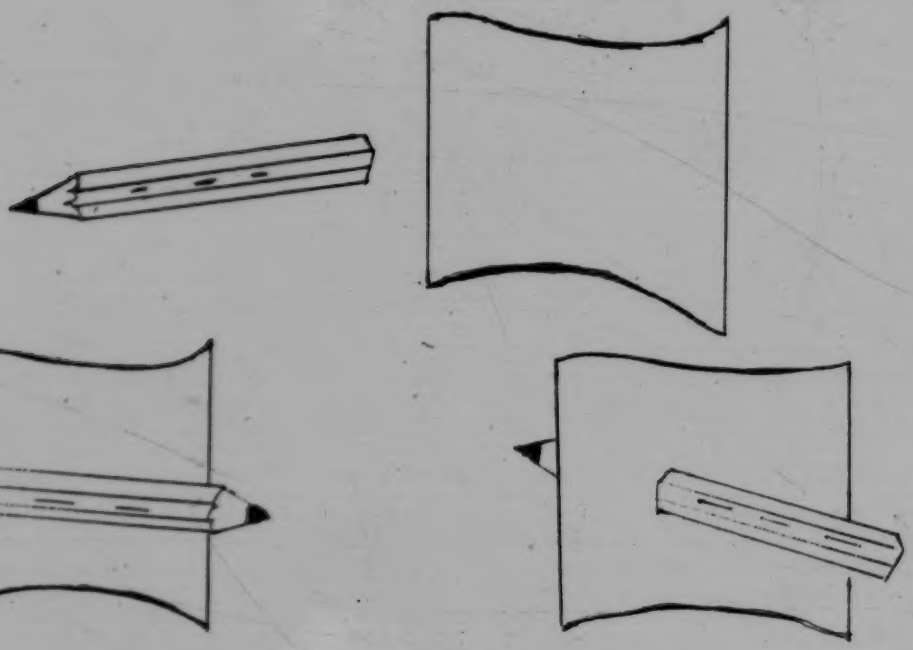

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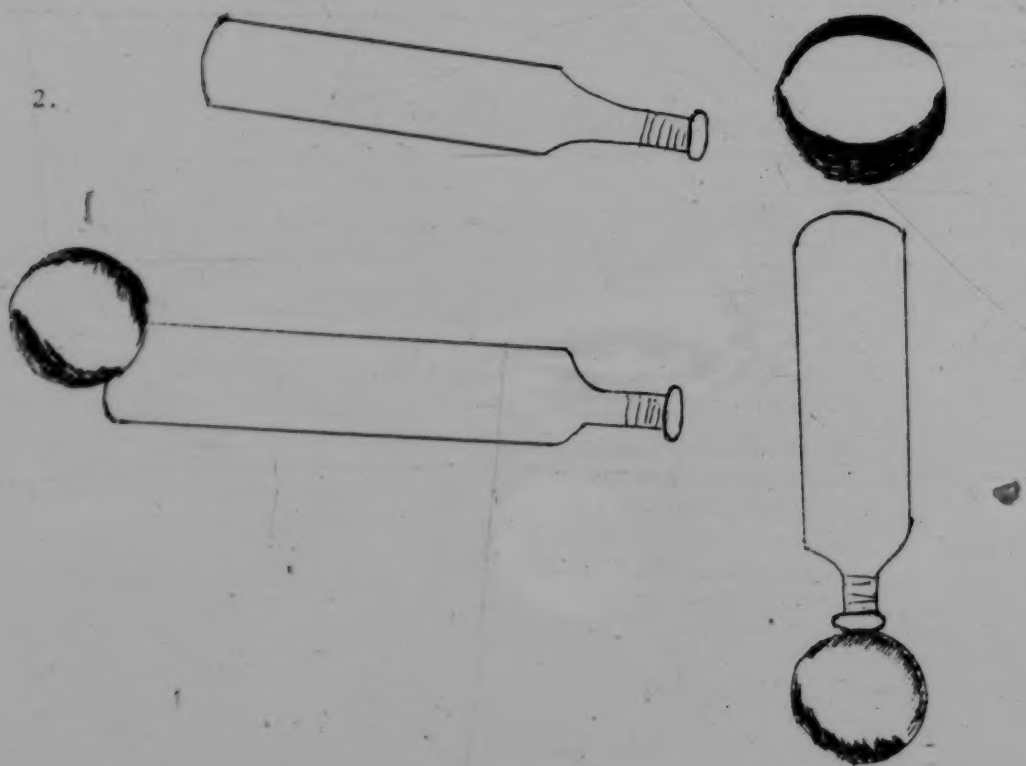

3.